MONTANA EARLY WARNING SYSTEM FOR DROPOUTS

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WHAT IS THE MONTANA EWS?

- A statistical model that can use readily available school, student, and other live data to identify students who are at risk of dropping out of school **before** they drop out.

  - The EWS allows educators to intervene early on during the process before a student has reached the point of no return.

HOW IS THE EWS DEVELOPED?

- Compare data from dropouts to the data from high school graduates from the school years 2007-2015

- Model is found using Logistic Regression

$$\pi(x) = \frac{e^{\alpha + \beta x_1 + \beta x_2 + \cdots + \beta x_n}}{1 + e^{\alpha + \beta x_1 + \beta x_2 + \cdots + \beta x_n}}$$

  - $\pi(x)$ is the percent chance a student will drop out of school

- Separate model is developed for each grades 6, 7, 8 and for each year of high school.

WHAT DATA IS AVAILABLE FOR THE MODEL?

- Data stored by the State.
  - Student Data
    - SIS (AIM) Data
    - Testing Data
  - School data
    - School Demographics
    - Location
  - Census Information
    - Unemployment Rates
    - Populations

- Data stored by the Schools
  - Attendance
  - Transcripts
  - Grades
  - Discipline

EWS MODEL DATASET

- Data from all Graduates and Dropouts from 2007-2015 school years at 13 school system's in Montana.

  - 13 school system's in Montana were sampled to give a good representation of schools across the state. (roughly 11,000 students per year, or about $1/6^{th}$ of the statewide students in 6-12th grades)

- Data current for each student at the end of the enrollment (whether a dropout or graduate)

  - Previous term data is usually from the 3rd quarter of the year.

  - This creates an assumption in the model that on average a student's data is the same at the end of the year as it is throughout the school year.

EWS HISTORY

- Pilot Year 2012-2013 (10 School Systems involved)

    - For the 2012-2013 school year EWS Results were sent to each school once a month

    - EWS was changed and updated many times during the school year.

- 2nd Year of EWS   2013-2014

    - Model was updated during the previous summer and remained unchanged throughout the 2013-2014 school year.

- 3rd Year of EWS 2014-2015

    - New model uses less variables that OPI does not collect (9 total)

- 4th Year of EWS 2015-2016

    - Available to all schools in GEMS

- 5th Year of EWS 2016 – 2017

    - New updated model completed before start of the new school year

    - Updates to current reports and working on Intervention Report

SCHOOL SYSTEMS CURRENTLY IN EWS

- Arlee
- Belgrade
- Bozeman
- Browning
- Butte
- Columbus
- Corvallis
- Cut Bank
- Frenchtown
- Great Falls
- Havre

- Huntley Project
- Lame Deer
- Laurel
- Lewistown
- Libby
- Livingston
- Park City
- Red Lodge
- St. Ignatius
- Townsend
- Wolf Point

VARIABLES IN THE EWS MODEL

Collected by OPI

- Moved this school year (Y or N)

- Moved from out of state (Y or N)

- Repeated a grade in K-8 (Y or N)

- Age Difference (July 15 cutoff date)*

- More than 2 SS's attended since 2007 (Y or N)

- Gender

About 300 Variables have been analyzed.

Not Collected by OPI

- Attendance Rate

- # of Previous Term F's

- # of Previous Term A's

- # of Behavior Events in last 120 days

- # of Out of School Suspension Events in last 3 years

- On Track (Y or N)

- # of Credits per year

- # of Absences in last 90 days

- # of Absences in last 60 days

TWO PARTS TO A GOOD EWS MODEL

1

- The Model should assign a high dropout percentage to students who end up dropping out.
  - Low dropout percentage to those that eventually graduate.
    - Can be evaluated by:
      - R squared
      - C-statistic
      - ROC Curves
      - Model AIC

2

- Model should be efficient in identifying dropouts above the cut-off threshold for targeting a student as At-Risk
  - A high percentage of At-Risk students end up being dropouts.
    - Can be evaluated by:
      - Confusion Matrix

WHEN IS A STUDENT CONSIDERED AT RISK?

- At what dropout percentage should we be concerned about a student?

  - Depends on school

  - Depends on how many incorrect conclusions you will accept.

- We want to be able to identify as many dropouts as we possibly can.

- We want as many of the students as possible to be in one of the "True" boxes.

  - Small number of students in the "False" boxes.

True Negative Model: Graduate Student: Graduate	False Negative Model: Graduate Student: Dropout
False Positive Model: Dropout Student: Graduate	True Positive Model: Dropout Student: Dropout

EWS MODEL EXAMPLES

Looking at Beginning of the Year EWS Results from 2009-2010

Only including students that had **all** data elements needed for the EWS. (4167 students total)

Must look at 2009-2010 to include 6th, 7th, 8th, 9th, 10th, 11th, and 12th grade students and allow time for them to graduate.

512 Dropouts from group of students that were in school 2009-2010 in the Pilot Schools

Marked as At Risk when >15%

True Negative Model: Graduate Student: Graduate 3132 75.2%	False Negative Model: Graduate Student: Dropout 131 3.1%
False Positive Model: Dropout Student: Graduate 523 12.6%	True Positive Model: Dropout Student: Dropout 381 9.1%

- Dropouts found – 74.4%
- Graduates found – 85.7%
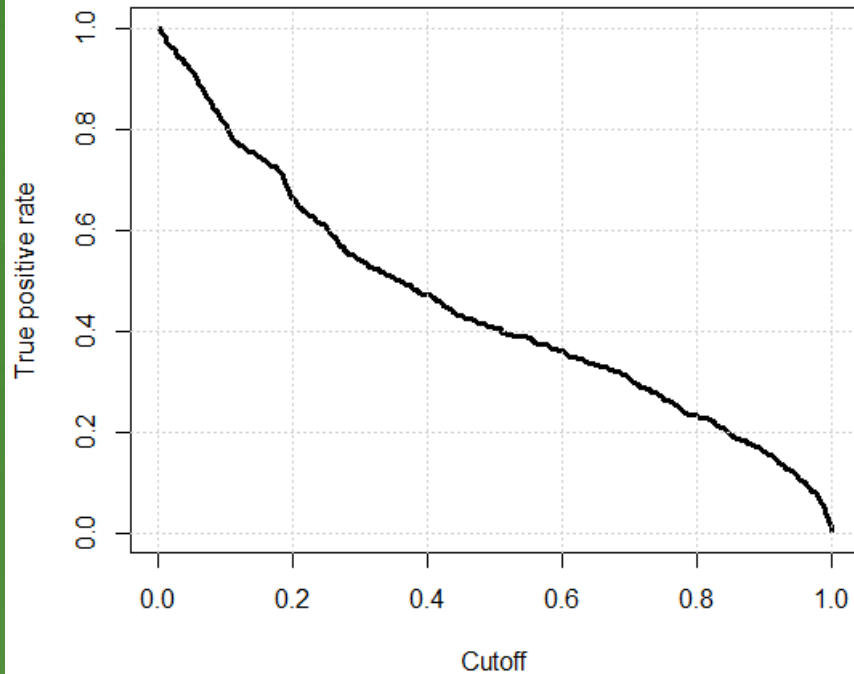- Accuracy – 84.3%

EWS MODEL DIAGNOSTICS

- ROC Curve and c-statistic

  - Graph of Sensitivity (True Positive Rate, % of Graduates correct) vs 1-Specificity (False Positive Rate, % of Dropouts correct)

  - Probability the model will assign a higher score to a randomly chosen dropout than to a randomly chosen graduate.
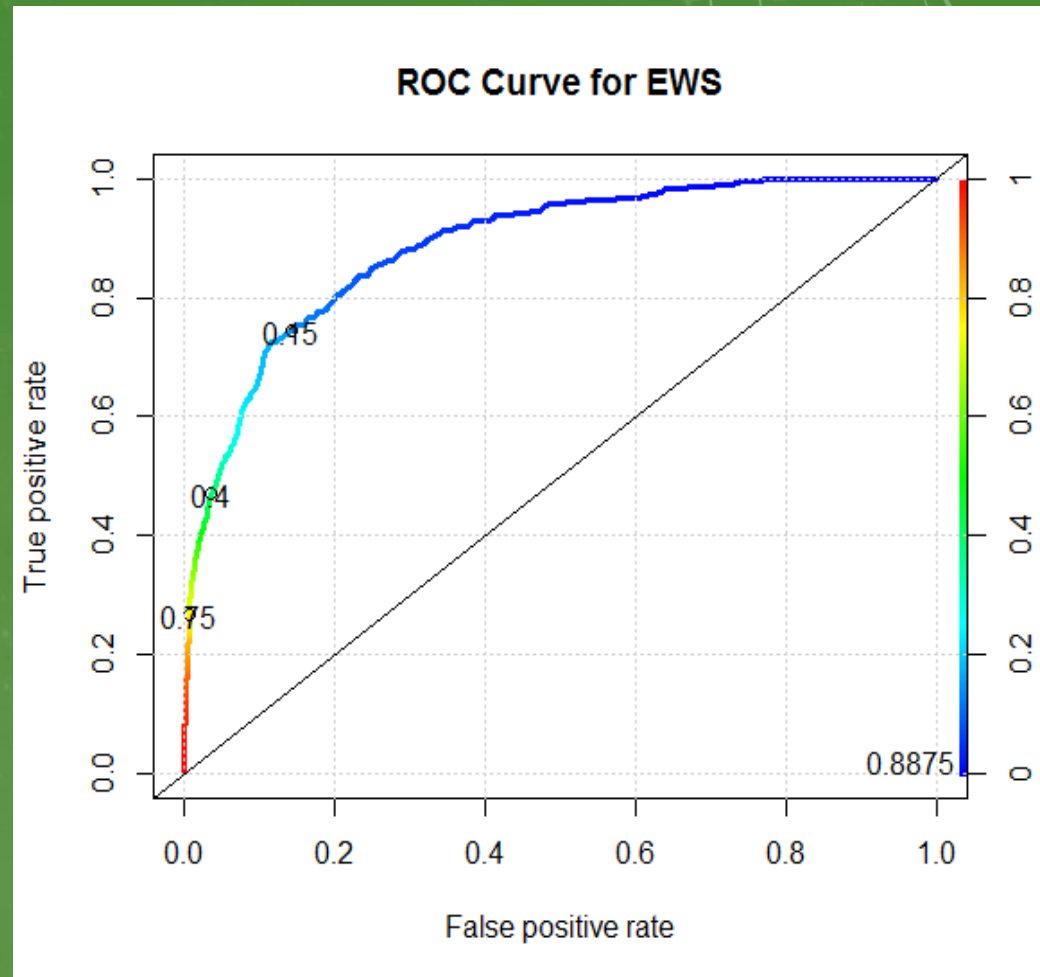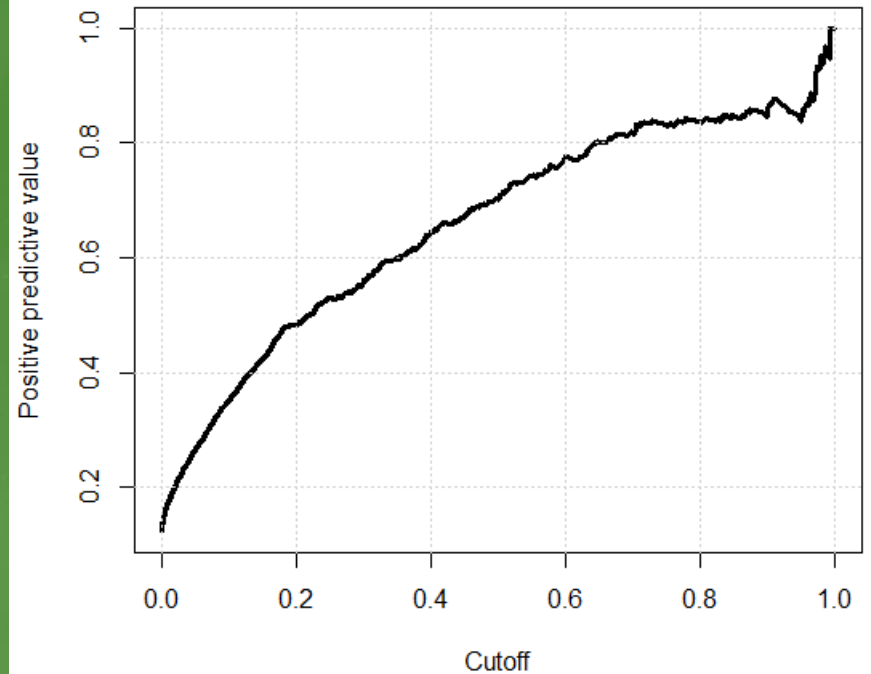
EWS MODEL DIAGNOSTICS

FULL MODEL DIAGNOSTICS

- R-squared

  - Measure of the fit of the model to data

  - Works a little different with logistic regression but similar to the r squared used with linear regression

- C-statistic

  - Probability a higher dropout value is assigned to a dropout than to a graduate.

Year	R squared	c-stat
6th Grade	0.449	0.861
7th Grade	0.501	0.885
8th Grade	0.522	0.895
1st Year HS	0.567	0.910
2nd Year HS	0.661	0.943
3rd Year HS	0.708	0.968
4th Year HS	0.777	0.987
5+ Years HS	0.728	0.941

2015-2016 SCHOOL YEAR EWS RESULTS

- Median Dropout percentage for all students in pilot schools for 5/1/15 results was 4.5%

  - 176 Dropouts total with EWS results on 9/3/2016 (beginning of the school year)

- 121 of the dropouts had dropout percentages of greater than 15%

  - Would have been targeted as At-Risk

  - 68.8% of Dropouts would have been identified at the beginning of the school year.

- Most had much higher percentages in the EWS.

  - Median Dropout Percentage of 158 dropouts was 56.2%

  - 51 of the 176 dropouts had over 90%

GEMS EWS RESULTS

- http://gems.opi.mt.gov/StudentCharacteristics/Pages/EarlyWarningSystemOverview.aspx

- EWS Results only available in GEMS Secure

  - Must get a login and access rights to the page.

- 3 Reports in GEMS

  - School Report

  - Student Summary Report

  - Student Detail Report

SCHOOL LEVEL REPORT

- Available for every school/district you have access to
  - School or district wide results to see numbers of students being identified.

- Can compare results by Grade

- Can compare to Statewide average results

- Will display results for the last 2 EWS runs
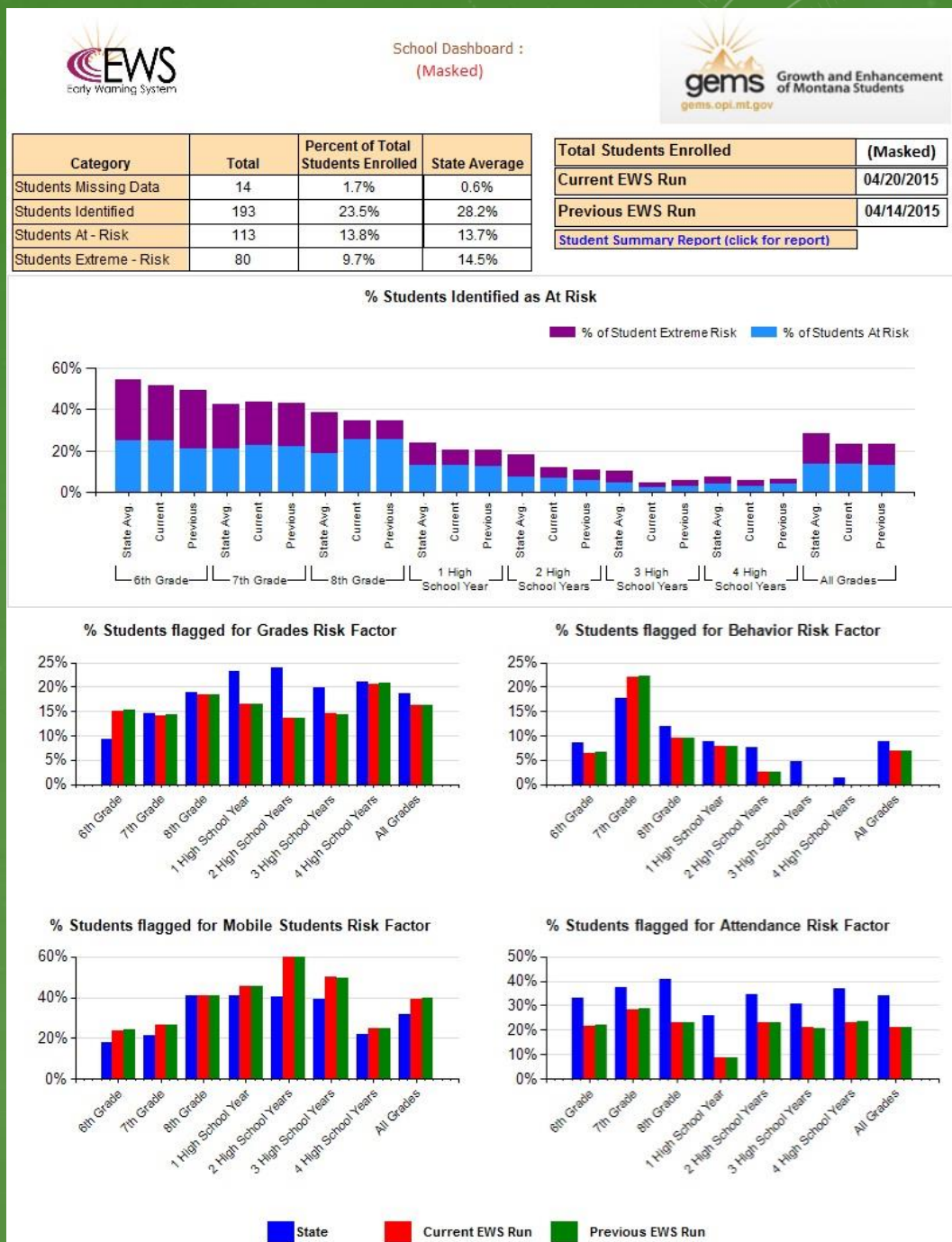
STUDENT SUMMARY REPORT

| SC	School Name	Last Name	First Name	StateID	HS Years	Grade	Dropout Prob.	Change	Est.	Attendance	Grades	Behavior	Age	Off Track	Mobility	Previous Dropout	Previous Prob.	Behavior Odds	Attendance Odds	Grades Odds	Mobility Odds
ABCD	Early Warning System School	Anderson	Joel	DJFHDFIEF	4	12	99.8%			Attendance	Grades			Off Track	Mobility	Prev Dropout	99.8%	1.00	41.45	61.25	2.21
ABCD	Early Warning System School	Smith	Maria	JDUEHJDH	4	12	0.1%			Attendance							0.1%	1.00	1.89	0.32	1.00
ABCD	Early Warning System School	Lackey	Edin	BGSFWFED	3	11	9.6%	⬇		Attendance			Age				24.0%	1.00	2.80	0.78	1.00
ABCD	Early Warning System School	Underman	Hal	IKJJHYGVX	3	11	6.1%	↗		Attendance					Mobility		3.0%	1.22	3.23	0.57	3.19
ABCD	Early Warning System School	Grossman	Keith	JSUWEHDBH	2	10	3.9%			Attendance							3.8%	1.06	1.49	0.28	1.00
ABCD	Early Warning System School	Player	Joe	IJUJHHUUS	2	10	0.4%										0.2%	1.00	0.83	0.21	1.00
ABCD	Early Warning System School	Stein	Thomas	ODJEHDYST	1	09	70.2%	⬆		Attendance	Grades	Behavior		Off Track			59.8%	2.92	2.95	6.14	1.00
ABCD	Early Warning System School	Caligher	Mary	DYSYDHEGD	1	09	1.8%			Attendance							2.1%	1.00	2.40	0.12	1.00
ABCD	Early Warning System School	Thompson	Jess	UDJEHEGDB	N/A	08	81.6%	⬆	*	Attendance		Behavior	Age				69.0%	1.32	2.28	1.00	1.00
ABCD	Early Warning System School	Banby	Shane	MSJDHEYDG	N/A	08	8.3%	↗		Attendance			Age				6.4%	1.00	2.37	0.35	1.00
ABCD	Early Warning System School	Smith	Jane	NSHDHEYRG	N/A	07	76.5%	⬇		Attendance	Grades						97.8%	1.00	3.59	8.46	1.00
ABCD	Early Warning System School	Anderson	Mike	MKNJBHGCC	N/A	07	13.7%	⬇		Attendance							36.0%	1.00	1.39	1.06	1.00
ABCD	Early Warning System School	Abbott	Megan	HUGYFTDRE	N/A	06	50.2%	⬆		Attendance		Behavior			Mobility		14.5%	1.85	1.39	0.62	4.92
ABCD	Early Warning System School	Cornrow	Mike	KDHSTDGXC	N/A	06	18.3%	⬆		Attendance							6.6%	1.23	1.35	1.05	1.00

- Lists EWS results for every student in your district/school in an excel file (other formats available)

* Names, School, and Data provided in the report is fictitious

STUDENT LEVEL REPORT

- Available for every student enrolled in your school

- Displays all data used by the EWS Model

- Graphically displays the following
  - Dropout Probability
  - Grades Risk Factor
  - Attendance Risk Factor
  - Behavior Risk Factor
  - Mobility Risk Factor

- Will display results for up to the last 12 EWS results

- Attendance Risk Factor Example
  - Based on grades alone, the odds of this student dropping out is 11.18 times the odds of an average student, with all other factors held constant
  - Above 1.25 all risk factors are flagged

* All names and data in report are fictitious *

At-Risk Tiers

~5%

~15%
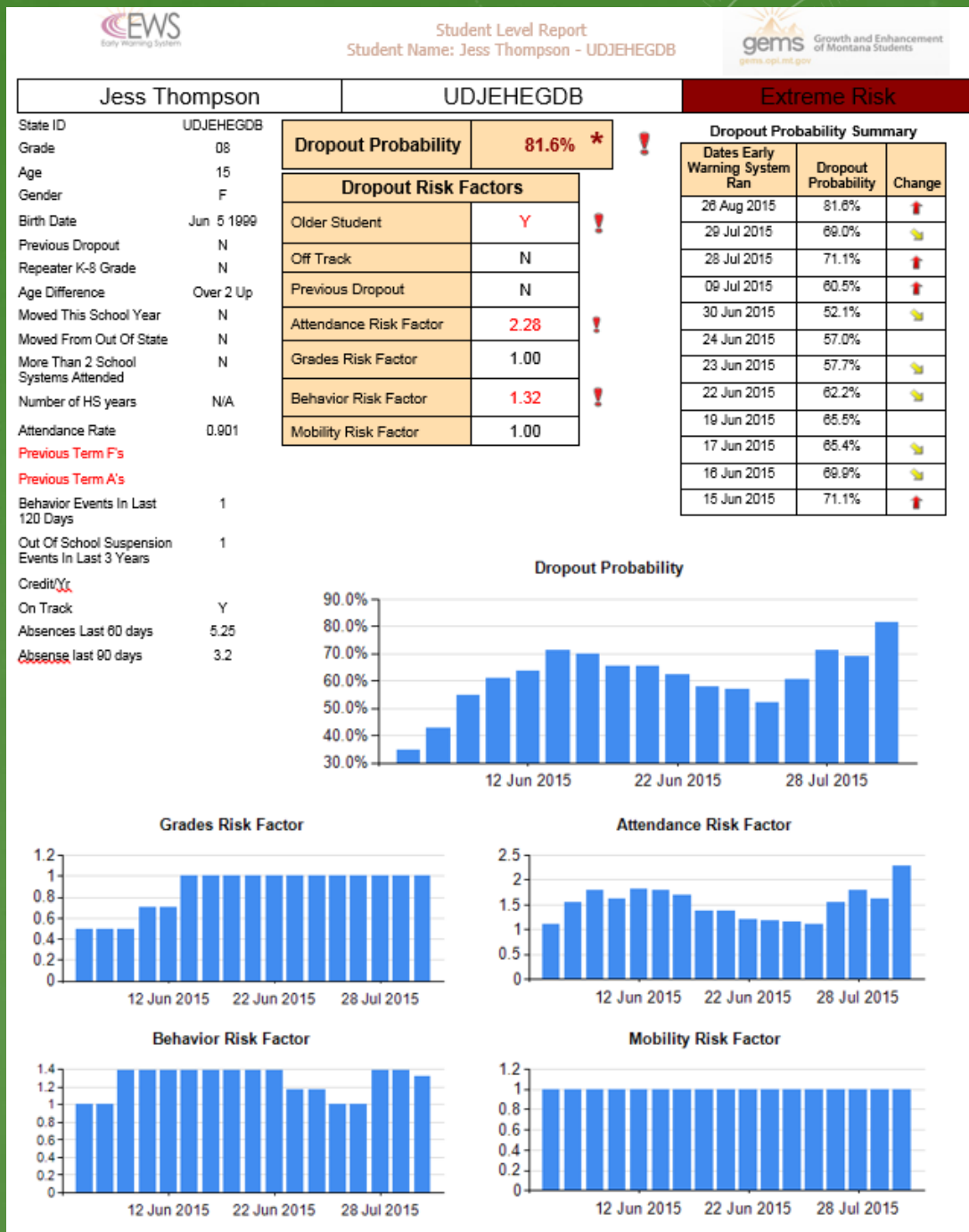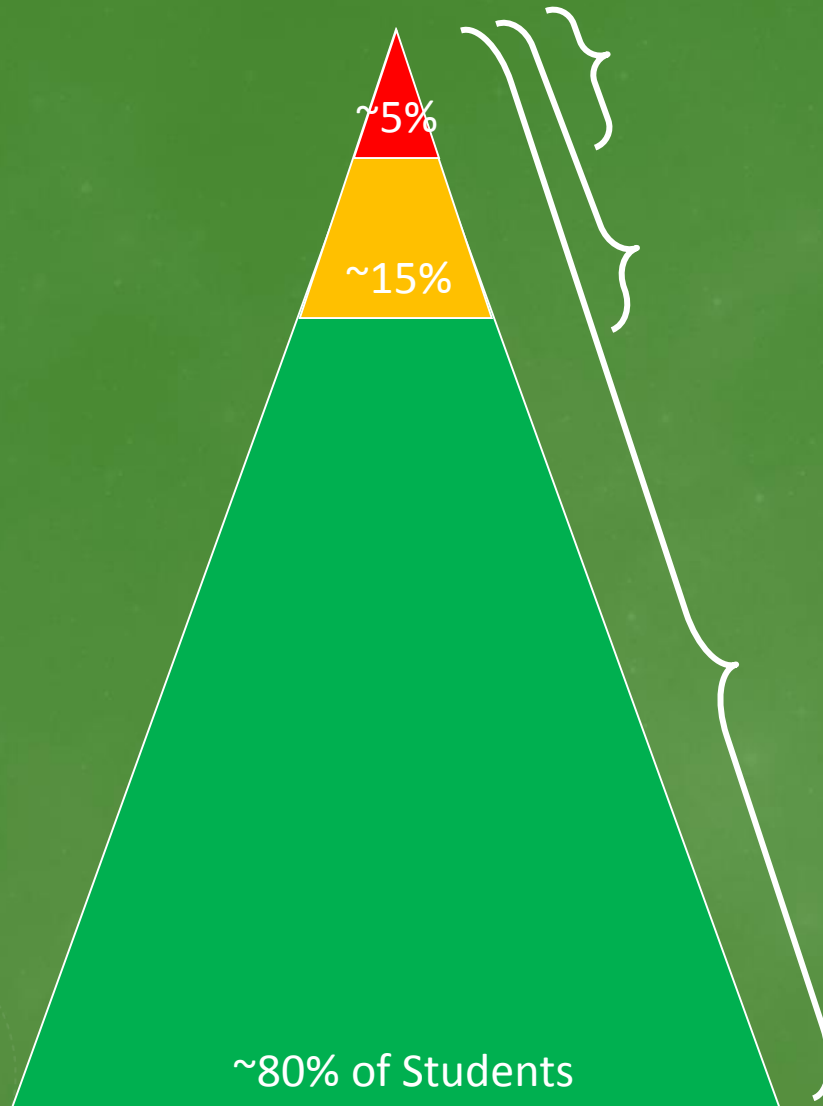
~80% of Students

TIER 3
Tertiary Prevention

EWS: Extreme Risk – 11.0% of Students

TIER 2
Secondary Prevention

EWS: At-Risk – 13.6% of Students

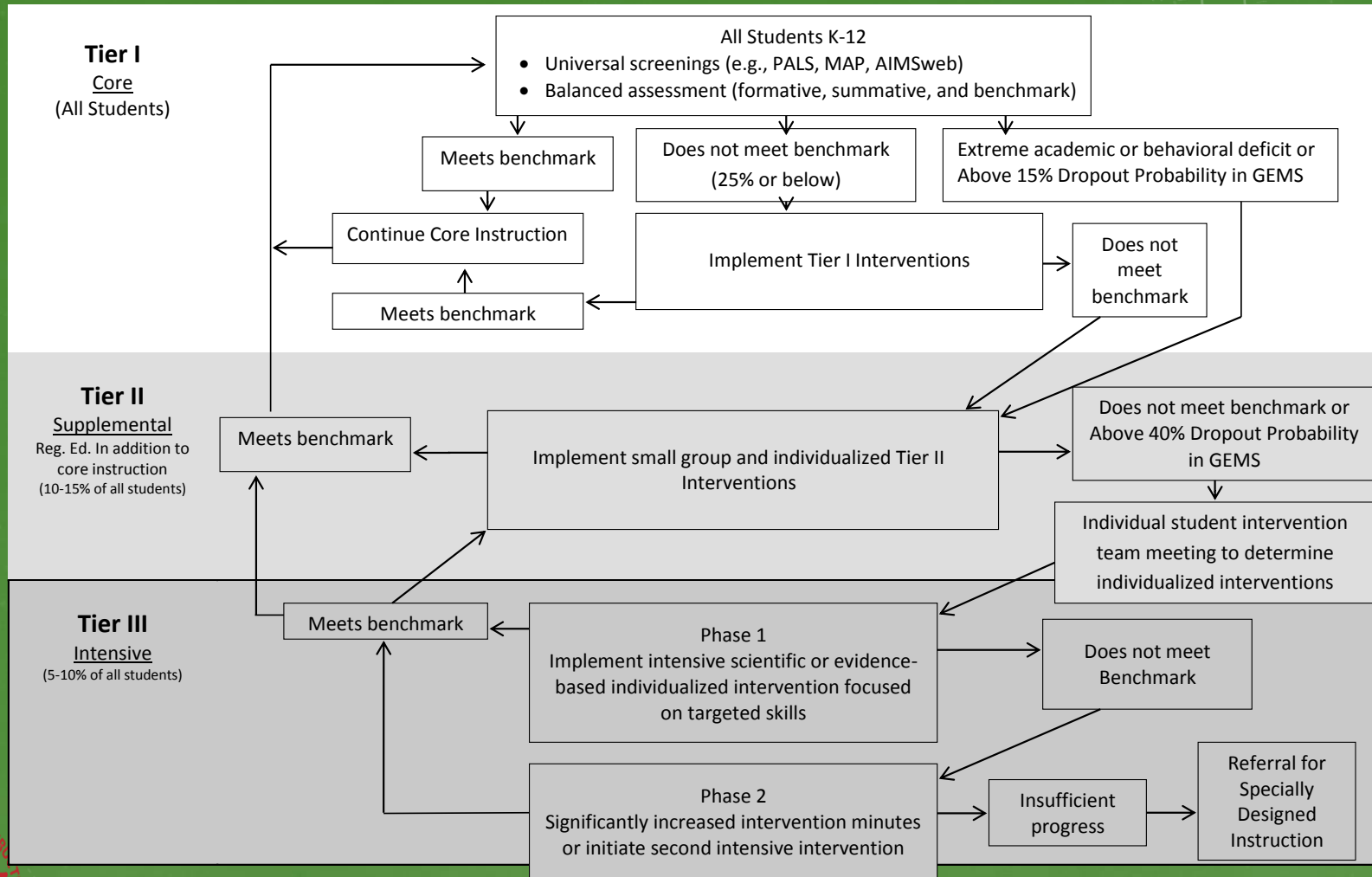**TIER 1**
Primary Prevention

EWS: Low Risk – 75.4% of Students

FLOWCHART (DRAFT)

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